8. *Annularia*, with six species, having twenty synonyms, and including plants previously referred to six other genera.

The ninth genus, *Aphyllostachys*, is altogether doubtful.

It needs indeed a bold systematist to attack such a chaos as this reveals, and an able one to deal with it effectively and well.

The work will consist of three parts :—(1) an introduction ; (2) a botanical classification of all known fossil plants ; (3) a synopsis of them in geological sequence ; with a Bibliographical Index.

The introductory part is very full, and is comprised in ten chapters :—

> Chap. I.—Historical sketch.
> Chap. II.—On the state of preservation of fossil plants.
> Chap. III.—Distribution of fossil plants in different formations.
> Chap. IV.—Different modes of preservation.
> Chap. V.—Principles to be followed in the determination of fossil plants.
> Chap. VI.—Of the changes which have taken place in the vegetable kingdom from its first appearance up to the present time.
> (§ 1.) Disappearance of species ;
> (§ 2.) The renewal of floras by the appearance of new types.
> Chap. VII. General *coup d'œil* of the floras of different geological periods.
> (1.) First epoch. Reign of the Thalassophytes.—(2.) Second epoch. Reign of the vascular Cryptogams.—(3.) Third epoch. Reign of the Gymnosperms. Appearance of Monocotyledons.—(4.) Fourth epoch. Reign of the Angiosperms. (*a*) First period ; Apetalous plants. (*b*) Second period ; Dialypetalous plants. (*c*) Third period ; Gamopetalous plants.
> Chap. VIII.—Application of vegetable palæontology to the climatology of the old world.
> Chap. IX.—Application of vegetable palæontology to geology.
> Chap. X.—General classification of stratified rocks.

Of the above chapters, the sixth, which deals with the renewal of floras by the appearance of new types, will be the first to be read by many, naturally eager to ascertain the views of so able and so unprejudiced a naturalist as Prof. Schimper, on the subject of the Origin of Species. In this matter his views are explicit, and he sums up his reasons for adhering to the doctrine of evolution in the following terms :—

> In spite, then, of the deficiency of palæontological documents, we cannot mistake the general line which Nature has followed through the various geological epochs, from the first appearance of organic beings to the period of their present development. This line may be termed one of evolution, because it marks a progressive change from inferior to superior, from simple to compound, precisely similar to that of every individual with a complicated organisation. All agree that the latter is the result of a continued series of metamorphoses. Every organised being begins as a simple cell ; the embryo itself being a complex organism derived from the generating cell ; wherefore there are naturalists who trace the individual back to the cell. We know, in fact, that each living vegetable cell can give birth to a new individual, of which it is in a certain sense the first representative. Many species of vegetables and animals do not rise above this simple cell ; as soon as this has given birth to a second cell, the latter becomes in its turn a fresh individual. Whenever the derived cells remain united, so that a sort of solidarity is established amongst them, the being which is born from this agglomeration is a complex being. It will be so much the more perfect, it will occupy a step so much the higher in the scale of organisms, as the differentiation of functions produced by the metamorphosis of the cells is more complete, and the organs applicable to these functions are more independent of each other.
>
> Has Nature followed this plan in her organic kingdom ? From all that we know, I believe that we are justified in such a conclusion. The only unicellular fossil plants with which we are acquainted are the Diatoms, which have left their siliceous shells in the most ancient of fossil beds. The cellular plants of the family of Algæ are doubtless rare in the palæozoic formations ; with the exception of some little epiphytal fungi, no terrestrial cellular plants have been discovered, either in palæozoic or in mesozoic beds ; this class is even but meagrely represented in the tertiary flora, which has nevertheless much affinity with that of the present day. Nevertheless, these scanty remains suffice to convince us that, if the cellular plants which were to prepare for the arrival of vascular plants have not left numerous and striking traces, they have none the less existed, and doubtless since the earliest periods. The first vegetation on the lands which had just appeared above the waters must have been composed of cellular plants, of Confervæ, of *proembryos* or *prothalliums* of a lower or higher order of Cryptogams, as may be seen at the present day on recently reclaimed land.
>
> The terrestrial vegetation of the Silurian epoch and of the commencement of the Devonian having left no trace, it is impossible for us to judge what were the forms of the plants which then covered the reclaimed land. All that we know is, that the primeval ocean was peopled by a numerous fauna during thousands of centuries before the appearance of vascular cryptogamic acrogens : similarly, if the Thalassophytes of those distant epochs had left no trace, their existence would be none the less infallibly proved by that of the animals whose food they formed.
>
> The rapid glance which we are about to give of the general character of the floras which have succeeded each other on the surface of the earth, from the Devonian period up to the present time, will show better than any reasoning the progressive march which they have followed, and the close links by which they are united to each other.

J. D. HOOKER

HARCOURT AND MADAN'S PRACTICAL CHEMISTRY

Exercises in Practical Chemistry. By A. G. Vernon-Harcourt, M.A., F.R.S., Sec. C. S. ; and H. G. Madan, M.A., P.C.S., Fellow of Queen's College, Oxford. Crown 8vo., pp. 350, 66 woodcuts ; 7*s.* 6*d.* (Oxford : Clarendon Press, 1869.)

WE are glad at last to welcome a really scientific work on Practical Chemistry. Professor Harcourt and Mr. Madan have earned the warm thanks of all interested in the teaching of the science by the publication of their volume. Almost all former works on practical chemistry have been contented either to act the part of illustrated catalogues of chemical apparatus, or else they consist of cut and dried receipts for following out a system of qualitative analysis by reference to a complicated series of paragraphs, ingeniously arranged to bewilder the unfortunate student as much as possible, or they place in his hands tabular statements of reactions which have to be worked through almost always without rhyme or reason.

Mr. Madan's Ten Commandments, or "Memoranda," placed at the commencement of the volume, might well be printed in letters of gold in every laboratory, and repeated as the morning lesson of each first year's student. "Cleanliness," he begins, "stands at *the head* of the *chemist's* scale of virtues." No better advice can be given : if a student can work neatly, he is almost sure to work well. Only rarely can the "messy" beginner be trained to habits of exact experimentation and accurate thought. The second ordinance is equally important : "Do not work in a hurry. What is expended in time is often gained in power and grasp of a subject. Yet, on the other hand, learn to be economical of time." The main object of a certain class of students seems to be to get "through" with their experiments, no matter how clumsily they manipulate, or how small and incomplete may be their knowledge of what the experiment teaches. They are satisfied to have "done the thing," and if they do not

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obtain the required result, they either think that something in nature has gone wrong, or that the author of the book is fibbing, and they are the last to imagine that they are themselves to blame; it is sufficient for them to have tried—or rather not tried—and they pass willingly to the next operation, most probably again to court defeat. To these the only cure is to act upon the advice, "Do not hurry." Another class of persons, to whom the second part of these "Memoranda" specially applies, are those who confine all their powers to waiting; thus they watch the slow filtration of a single gelatinous precipitate, and with a kind of dreary pleasure either dream away their time, or (more commonly) annoy their more diligent neighbours, thinking that nature is invariably slow to move, and that patience is the only virtue they need to cultivate. These must be made to learn that economy of time is a necessary part of the chemist's duty, and that he, "in spite of the proverb, may do more than one thing at a time by allowing things to do themselves." The chemist's third commandment is fairly given as, "Be economical of materials." Who that has seen beginners work does not value this recommendation? Many seem to think that the more they deluge the substances they have to examine, first with acids, and then with alkalies, the more likely are they to discover the philosopher's stone, or to find their needle in the bottle of hay! How long some students take to find out that every molecule of acid or alkali, added above the required quantity, serves only as a blind to their reactions, and is in reality a most wilful adulteration of their material, with perhaps several thousand times its weight of dirt. "Never begin an experiment," says Mr. Madan, in his fourth article, "until you have looked over all the preparations for it, to make sure that you have everything within reach;" and we would make this advice apply not only to test-tubes and gas-jars, but to the mental preparation also. No experiment ought to be made until the student knows what he is going to do. He must either read a description of what he is to do, or he must see the experiment performed by his teacher; and, above all, he ought to be aware of the theoretical explanation of the changes he is about to witness. The writer for one does not think that laboratory instruction cannot be valuable, unless the student has already acquired a certain knowledge of the subject by attendance on lectures; but the theoretical instruction must then of necessity accompany the practical tuition. The very first experiment which the beginner may make—viz. that of heating oxide of mercury in a test-tube—must be the occasion for an explanation of the laws of definite combination by weight, for a statement of the numerical exactitude of all chemical change. Exercises must at once be given, and continue to be given, in illustration of these laws; and thus from the first the student must be made to grasp the facts of the exact nature of the science. He must be disabused at once of the notion of some who, when they enter the laboratory, "look upon chemistry as a mere amusement, as a means of getting up a few explosions, creating a few unsavoury smells, producing a few striking changes of colour." Unless practical chemistry is taught with these aims, in a manner calculated to afford an exact mental discipline, it is worse than useless. If the student does not cultivate habits of attention, close observation, and patient inquiry, he can gain nothing from laboratory work; on the contrary, he becomes negligent and impatient, he does not care to look for what is going on, and instead of gaining immensely, as he ought, in habits of self-reliance, he loses all confidence, finds physical science a delusion and a snare, and returns (if he has any taste for learning at all) to the more congenial path of literature.

The volume in question will much aid those who teach with this view, and it will afford still more active help to those who, possessing no teacher, have to learn for themselves.

The descriptions of the simpler operations of glass-working in the beginning of the volume, and of the construction of tube apparatus, are clearly given; and these pages are, of course, especially interesting to the self-educated student. The exercises on solution, precipitation, filtration, and distillation, are described with care, and the examples well chosen. It is very difficult to know how far such descriptions should go as regards details. The description of the manufacture of lime-water is as clear as that preparation ought to be. But is such detail needed where a word of explanation can be given? This shows the impossibility of writing a book on practical manipulation exactly fitted for all classes of students.

In the second section, on preparation and examination of Gases, we miss the theoretical explanations which, as we have said, must accompany the practical and manipulating directions; nor do questions, numerical or otherwise, accompany the exercises. This is to be regretted: a book especially written for those who work alone should contain a series of examples such as we find in many of the smaller manuals. With this exception this portion of the book is as good as need be. A chapter on the preparation of Reagents in use in the laboratory is especially valuable to the self-taught student. The solutions are made according to system; and in the preparation the student is familiarised with the metrical system of weights and measures: whilst under each heading the tests for the purity of the reagent are given; thus:—

> Barium Chloride ($BaCl_2$ in 20 c.c.) Dissolve 12·2 grms in 80 c.c. of water, and dilute to 100 c.c.
>
> The purity of the salt may be tested as follows. Place about 5 c.c. of the solution in a test-tube, heat it nearly to boiling, and add a slight excess of dilute hydrogen sulphate. While the precipitate of barium sulphate is subsiding, get ready a filter (of Swedish paper), wash it two or three times with warm water, then filter off the barium sulphate and evaporate the filtrate to dryness on a clean watch-glass. No solid residue should be left.

The authors, in their introduction to Qualitative Analysis, commence with the study of the acid radicles instead of the metals. This is, perhaps, the more scientific order of procedure than that beginning with the reactions of the metals; but we must take leave to doubt whether it is so simple, or so likely to conduce to the clear understanding of the reactions as the other older and more usually employed method.

The nomenclature used throughout the work possesses one amongst many advantages over the others (unfortunately too numerous) now in use, in that it is identical with that now employed in Germany. Surely it is a matter of some importance to assimilate as much as possible scientific nomenclature in all languages.

H. E. ROSCOE

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